case lies in the fact that the antipodal point corresponding, being S. lat. 19° 21′ and E. long. 115° 38′, lies about 100 miles north by east of Barrow Island, off the west coast of Australia. It is further interesting to note that the line which joins this point with the southern point of Barrow Island fairly represents the direction of the coast-line at this point, and leads to the presumption of the existence of main lines of faulting there having that direction. To this relation of antipodean points in connection with earthquakes I have already had occasion to call attention.

J. P. O'Reilly

Royal College of Science, Dublin, December 22

Barnard's Comet

This comet has been observed here with the 7½-inch refractor, with power 50, than which no higher power could be used with advantage.

On December 19, at 18h., it appeared as bright as a 2nd magnitude star similarly situated; the nebulous head was about 10′ in diameter, with central condensation of perhaps half a minute. The "position" of the principal tail was estimated to be 0°: it remains of a parallel breadth throughout, and does not increase in breadth as it recedes from the head of the comet; this constant breadth is equal to the diameter of the nebulous head, that is to say, 10′. By sweeping, this tail may be traced to a distance of some 10° from the head.

The secondary tail is inclined at an angle of between 30° and 40° to the principal one, and fades away rapidly at a distance of perhaps 1° from the head; it is well defined on the preceding side, but on the following side it melts away into a nebulous mass connecting it with the principal tail for some distance from the head.

On the 27th, at 19h., the comet was decidedly less bright than on the 19th, but the same general description applies.

The "positions" of the two tails were measured, and were: the principal tail, 15°·5; the secondary, 338°; the included angle, 37°·5 ± 0°·5. The secondary tail did not appear as well defined, on the following side, as on the 19th.

Finlay's comet presents no visible feature of interest.

Wentworth Erck

Shankill, co. Dublin, December 28

Electricity and Clocks

In the absence of any details, apparently Mr. Wilson's simplest plan would be to insulate the hammer and bell of his "small striking clock," and arrange that a galvanic current should pass through both, when they come in contact by the act of striking: this current of course to be directed to a large electro-magnet, to raise the hammer for striking on his bigger bell. Should the striking of Mr. Wilson's smaller clock be on a gong with a leather-beaked hammer, a separate attachment must be made for contact.

Henry Dent Gardner

Lee, S.E., December 26

P.S.—If a longer contact be desired, the hammer whilst at rest should repose upon a weak spring, and be kept away from a banking; when the hammer rises, contact will ensue between the spring and banking, and last until the hammer falls again.—H. D. G.

Seismometry

There are one or two points in Prof. Ewing's letter on the above subject in the last number of Nature which seem to call for a few words of reply.

(1) As to the alleged inconsistency between what I wrote in 1881 and what I wrote in my last letter. The remark quoted referred to a light pivoted frame carrying at its centre of percussion, relatively to the axis through its pivot, a pivoted mass. There was no "if need be" about this mass: it was an essential part of the system. I believe the remark I then made was perfectly correct and in no way inconsistent with my remarks in 1886.

(2) As to the vertical-motion instrument, the lever with spring joint used at Comrie in 1842 does not at all resemble the rigid lever working on knife edges and supported by springs as introduced by me and used by Prof. Ewing. On the question of compensating the lever by the addition of negative stability, I have nothing to add to what I stated in my last letter.

(3) As to the publication referred to by Prof. Ewing, the memoir printed by the Tokio University is probably, from the circumstances of its publication, hardly known to anybody. The "Encyclopædia Britannica" article is not, in my opinion, a fair account of what has been done in seismometry.

Thomas Gray

7, Broomhill Avenue, Partick, December 27

The Recent Weather

At Cardross, half-way between Dumbarton and Helensburgh on the Clyde, at about 25 feet above sea-level, in an outer lobby with a temperature of say 45° to 50° F. at 9 a.m. on Wednesday, the 8th inst., the mercurial barometer stood at 27·51 inches, which, with reduction of say 0·02 added for elevation, and say 0·03 subtracted for temperature, would make it 27·50 inches. On January 26, 1884, it stood at 27·39 inches, which with like reductions would give 27·38 inches. These are nearly as low as those you refer to in your number for last week.

Cardross, Dumbarton, December 23 R. B. W.

OBSERVATIONS OF NEBULÆ AT ARCETRI[1]

M. TEMPEL observes under difficulties. The Arcetri Observatory possesses, it is true, two fine refractors by Amici, one of 11, the other of 9⅓ inches aperture; but neither is, properly speaking, available for astronomical use. The smaller is rudely set up on an open and uneven terrace, exposed to every gust of wind, and, at the most, serves to display the wonders of the heavens to curious visitors. Amici I. is duly ensconced in a revolving dome, but clockwork motion is wanting; the circles, both of declination and right ascension, are (strange as it may seem) *undivided;* and when the necessarily somewhat unwieldy instrument is, with infinite pains and without so much as the aid of a handle, pointed towards the object sought, there is actually no means of clamping it in the position so laboriously arrived at! That M. Tempel, under circumstances so discouraging to him and disgraceful to the responsible authorities, should have executed a number of valuable drawings of nebulæ, should have re-observed many such objects neglected, or even believed to have disappeared, since the elder Herschel's time, besides discovering a good proportion of new ones, gives astonishing proof of his keenness, zeal, and accuracy. All the more, nevertheless, there is reason to regret that qualities so rare should be employed at such cruel disadvantage for want of the judicious expenditure of a couple of thousand francs.

The paper before us is accompanied by reproductions of two admirable drawings by the author, one of the Orion, the other of the "Crab" nebula (Messier I.). The latter is of especial interest, as disclosing a feature unnoticed by any previous observer. This is a dark cleft right through the central condensation, dividing it along the major axis into two spindle-shaped nebulæ. Incipient fission would seem to be indicated. On the same plate with his own, M. Tempel has engraved five earlier drawings of the object, by J. Herschel, D'Arrest, Lassell, Secchi, and Lord Rosse. The comparison is instructive, if somewhat disheartening; for, assuredly, no two of the six confronted delineations could be supposed, on an unprejudiced inspection, to have been inspired by one original. Yet the nature of that original sufficiently explains the discrepancies. The apparent form of nebulæ depends upon almost evanescent gradations of diffused faint light, and differs, for each individual eye, with its sensitiveness to them. And since personal equation, as regards such gradations, is shown by many proofs to be enormously large, a vast amount of detailed variation in the representation of the objects exhibiting them becomes intelligible. It is, then, a circumstance of pecu-

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[1] "Ueber Nebelflecken. Nach Beobachtungen angestellt in den Jahren 1876-79 auf der Königl. Sternwarte zu Arcetri bei Florenz." Von Wilhelm Tempel. Abhandlungen der Königl. Böhm. Gesellschaft der Wissenschaften. VII. Folge, 1 Band. (Prag, 1885.)

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liarly good omen for progress in the study of nebulæ that a mode of record at once so fluctuating and so laborious as that of hand-drawing should be replaced (as it will no doubt soon wholly be) by automatic impressions which, with some points of inferiority, at least leave no room for "individualism."

M. Tempel's description of the Merope nebula (discovered by himself in 1859), and his remarks on the great elliptical mass in the girdle of Andromeda, derive particular interest from recent events. His observational faculty, and the high quality of his telescope, are illustrated in the disclosure to him, by Amici I., of nearly 900 stars in the Pleiades, all of them comprised within the field of view of a 4-inch Steinheil bearing a magnifying-power of 24. With the former instrument he detected independently on September 30, 1875, a few days before reading Bond's description of them, the strange obscure channels in the Andromeda nebula; and has since with some difficulty made out similar markings in some small nebulæ of the same class. They would accordingly appear to be a more or less characteristic feature of "oval" nebulæ, and might perhaps be assimilated to the symptoms of partial duplication in Messier I.

In respect to the nature of nebulæ, our author's experience leads him decidedly to adopt the view of their close connection with stars. He shows, indeed, for spectroscopic evidence a disregard that is neither philosophic nor just; yet his contention that *purely gaseous* nebulæ do not exist, is probably well founded. No aggregation of celestial mist, at any rate, has ever been observed by him in which his 11-inch failed to reveal the pricking light of minute stars, marking some knot or nucleus, and thereby evincing structural relations of a most intimate kind.

THE MATHEMATICAL TRIPOS[1]

III.

WHEN the interval between the earlier portion of the examination and Part III. had been extended to a year, it became evident that some substantial relief must be afforded to the examiners. By the existing regulations a person who accepted the office of Moderator would have to take part in the examination in three consecutive years, and in his second year of office he would have to examine the candidates of one year in Part III. simultaneously with those of the year below in Parts I. and II. This led to the consideration of the whole question of the appointment of examiners. The two Moderators in each year are nominated by two colleges, according to a prescribed cycle of fifty years. This nomination by colleges, though theoretically not very defensible, had worked very fairly so long as the examination only included subjects with which any high wrangler might be expected to be acquainted; but it was clearly unsuitable for Part III. In any case the nomination of the four examiners by four independent bodies might easily bring about the result that among the various subjects included there would be some which had not been made the object of special study by any of the examiners: indeed there was nothing to prevent the four examiners being all pure mathematicians or all physicists. Accordingly, with a unanimity almost unique in matters relating to the Tripos, the Board recommended in a Report dated June 15, 1885, that the examiners for Part III. should be quite distinct from those for Parts I. and II., and that all four should be nominated by the Board. It was also proposed that they should hold office for only one year. This Report was sanctioned by the Senate on October 29, 1886. In future, therefore, the Moderators will not take part in the highest portion of the examination. The appointment of Moderators dates from 1680. Previously the Proctors had themselves presided in the schools, but in that year the duty of conducting the disputations was transferred to the Moderators, who were specially appointed to perform this office. The Moderators have always been, and still remain, high University officers, ranking next to the Proctors.[1] Not only were they the earliest examiners in the University, but it is to them that we owe the origin of the examination system. Their severance from a portion—and that the highest portion—of the examination is therefore a notable event in the history of the Tripos. Neither the Board nor the University would have agreed lightly to such a break in the traditions of the Senate House examination, had it been possible to retain the Moderators as examiners for the final part without altering the system of nomination by colleges. The complete separation of Part III. from the earlier parts of the examination was, however, inevitable. Many members of the University who would discharge most admirably the duty of examining for Parts I. and II. would shrink from Part III.; and the professors and specialists who were best fitted to examine in Part III. would generally be reluctant to undertake the heavy burden of examining all the candidates for Parts I. and II., especially in two consecutive years.

Thus, by the irresistible pressure of events, it has come to pass, in the last few years, that not only the titles of wranglers, senior optimes, and junior optimes have lost their old significance and refer only to the earlier examination, but that even the more ancient title and office of Moderator has undergone a similar restriction. The final part of the examination has indeed made rapid progress: within three years of its first coming into existence it has emancipated itself from union with the earlier parts, and become an independent examination.

Besides these important innovations, the Senate sanctioned at the same time a slight change in the nomenclature of the Tripos, the earlier portion of the examination, previously called Parts I. and II., upon which the list in order of merit depended, being designated Part I., and Part III. being henceforth designated Part II. This change was made in order to bring the nomenclature of the Mathematical Tripos into harmony with that of the Classical and other divided Triposes.

As soon as Part II., to adopt its new name, became an independent examination, the Board directed its attention to the schedule of subjects relating to it. The existing schedule contained only those subjects which had been included in the schedule which came into operation in 1873, when the results of the whole examination were still expressed by one final list, arranged in order of merit. Now that Part II. was a separate examination, and that there was no order of merit, the reasons for the limitation of the subjects had been entirely removed. Although the theory of elliptic functions, which dates only from the publication of Jacobi's "Fundamenta Nova" in 1829, was included, the theory of numbers, which had its origin in Gauss's "Disquisitiones Arithmeticæ" of 1801, was still excluded. Abelian functions, the theory of functions of a complex variable, projective geometry, and quaternions were not formally included by name, and questions on these subjects could only be set, if at all, by straining the meaning of the title of some other subject. Besides the total exclusion of certain branches of pure mathematics, a further reason for revising the existing schedule was afforded by the fact that the four groups A, B, C, D were very unequal both in magnitude and popularity among the students. According to the existing regulations the four groups had to be equally represented by questions,

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[1] Address delivered before the London Mathematical Society by the President, Mr. J. W. L. Glaisher, M.A., F.R.S., on vacating the chair, November 11, 1886. Continued from p. 157.

[1] It is still the custom for the list of wranglers, senior optimes, and junior optimes to be shown to the senior Proctor on the evening of the day before it is read in the Senate House. This is doubtless a relic of the fact that the Moderators were originally the substitutes of the Proctors. It has been already mentioned that the Proctors, as well as the Vice-Chancellor, used to have the right to insert a certain number of names where they pleased in the Tripos list.

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